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Inventor:	JOBST ULRICH GELLERT		
Serial No.:	09/195,095	Group:	3729
Filed:	November 18, 1998	Examiner:	S. Smith
Title:	Apparatus and Method of Making An Injection Molding Nozzle with Tip Insert	Docket No.	P99065
			September 30, 1999

[illegible]

To effect the above requested filing today:

1. [X] Attached is a copy of the prior application as originally
 filed, including:
- [X] Specification and claims as originally filed
 [X] Declaration or oath as originally filed
 Sheets of Drawings: 5 Formal [X]; Informal [].
- a. [X] DECLARATION: The undersigned hereby declares that he
 believes the attached is a true copy of the prior
 application as originally filed. It is further declared
 that the foregoing statement is believed to be true; and
 further that this statement is made with the knowledge that
 willful false statements and the like so made are punishable
 by fine or imprisonment, or both, under Section 1001 of
 Title 18 of the United States Code and that such willful
 false statements may jeopardize the validity of the
 application or any patent issuing thereon.
- b. [] An affidavit verifying the attached application copy as a
 true copy is enclosed.
2. [] Prepare a copy of the prior application.
- a. [] prepare and send the undersigned a copy of the prior
 application, charging the cost to Account No. 04-0076.
3. [X] The Commissioner is hereby authorized to charge any
 additional fees which may be required now or hereafter
 relative to this application and the resulting Official
 Document, or credit any overpayment, to Account No. 04-0076.

4. ☐ Transfer the drawings from the prior application to this application and abandon said prior application as of the filing date accorded this application. A third copy of this letter is enclosed for filing the prior application file.
5. ☒ Priority is hereby claimed under Rule 55 and 35 U.S.C. 119 based on prior foreign application No. 2,250,599
 filed in Canada
 on October 16, 1998,
 respectively.
- a. ☐ Certified copy (copies) attached.
- b. ☒ Certified copy (copies) already filed on
December 28, 1998 in prior
 U.S. application, Serial No. 09/195,095,
 filed November 18, 1998.
6. ☒ The prior application is not assigned.
7. ☒ The power of attorney in the prior application is to R. Dale McKenzie, Reg. No. 26,117.
- a. ☒ The power appears in the original papers of the prior application.
- b. ☐ Since the power does not appear in the original papers, a copy of the power in the prior application is enclosed.
8. ☒ Address all future communications to Dalesman & Company, Suite 400, 1465 Ellis Street, Kelowna, British Columbia, Canada, V1Y 2A3, telephone (250) 868-3003.
9. ☒ Amend the specification by inserting before the first line the sentence: --This is a [x] continuation of application Serial No. 09/195,095 filed November 18, 1998.
☐ divisional
10. ☐ Cancel claims _____

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11. ☒ A preliminary Amendment is attached.
12. ☐ An executed Small Entity Declaration.
☐ is attached
☐ was filed on _____ in S.N. _____
filed _____.
13. ☒ The filing fee as calculated below is enclosed:

CLAIMS AS AMENDED

				SMALL ENTITY		OTHER THAN A SMALL ENTITY	
		NO. FILED	NO. EXTRA	RATE	FEE	RATE	FEE
BASIC FEE					\$		\$760.
TOTAL CLAIMS	34	-20=	14	x 9=	\$nil	x18=	\$252.
INDEP. CLAIMS	5	-3 =	2	x39=	\$nil	x78=	\$156.
MULTIPLE DEPENDENT CLAIM PRESENTED				+135=	\$nil	+270=	\$
				TOTAL	\$	TOTAL	\$1,168.
					=====		=====

If the difference in Co. 1 is less than zero, enter "0" in Col. 2

DALESMAN & COMPANY

By: 
Name: R. D. McKenzie
Registration No. 26,417

RDM:ah
Encl.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:) Atty. Docket: P98068
JOBST ULRICH GELLERT) Group Art Unit: 3729
Serial No. 09/195,095) Examiner: S. Smith
Filed: November 18, 1998)
)
Title: Apparatus and Method of)
Making an Injection) Kelowna,
Molding Nozzle with) British Columbia
Tip Insert) September 30, 1999

PRELIMINARY AMENDMENT

The Hon. Commissioner of Patents
and Trademarks
Washington, D.C., U.S.A.
20231

Dear Sir/Madam:

Prior to calculating the filing fees, please
amend the above identified application as follows:

IN THE TITLE

Please change the title from "Method of Making an
Injection Molding Nozzle with Tip Insert" to --Apparatus
and Method of Making an Injection Molding Nozzle with Tip
Insert--.

IN THE SPECIFICATION

Page 2, line 2, after "to", please add --
apparatus and--.

Page 4, line 2, after "providing", please add --
apparatus and--.

Page 9, line 3, please change reference numeral
"58" to reference numeral --57--.

- 2 -

IN THE CLAIMS

Please cancel claims 1 - 14 and substitute therefore claims 1 - 34 attached herewith.

IN THE DRAWINGS

Please amend Figure 6 presently on file with Figure 6 attached herewith in duplicate. Figure 6 was amended to add reference numeral --57--.

REMARKS

The title and pages 1 and 4 of the disclosure have been amended to refer to apparatus as well as a method.

Page 9 has been amended to change reference numeral "58" to --57--.

The claims have been revised to more clearly recite the scope of the invention.

Favourable consideration and allowance of this application is respectfully requested.

Respectfully submitted,

JOBST ULRICH GELLERT

By: 

R. D. McKenzie
Reg. No. 26,117

**METHOD OF MAKING AN INJECTION MOLDING
NOZZLE WITH TIP INSERT**

BACKGROUND OF THE INVENTION

This invention relates generally to injection molding and more particularly to a method of making a heated injection molding nozzle with a tip insert.

As seen in the applicant's U.S. Patent Numbers 4,557,685 which issued December 10, 1985 and 4,768,283 which issued September 6, 1988, injection molding nozzles having a tip aligned with the gate to provide hot tip molding are well known. Apparatus having a hot tip provided by a torpedo seated in the front end of a nozzle is also known. For instance, the applicant's Canadian Patent Application Number 2,082,700 which was laid open May 13, 1994 shows a torpedo having a tip held in place by a nozzle seal which slides into a seat in the front end of the nozzle. U.S. Patent Number 5,658,604 to Gellert et al.

which issued August 19, 1997 similarly shows a torpedo with a tip which is held in place by a nozzle seal which is screwed into a seat in the front end of the nozzle. As seen in the applicant's U.S. Patent Number 5,494,433 which issued February 27, 1996, it is also known to have the tip provided by a side gate seal which screws into the nozzle.

As seen in U.S. Patent Number 5,704,113 to Mold-Masters which issued January 6, 1998, a method of making a nozzle wherein an inner portion, an outer collar portion and an electrical heating element are integrally brazed together is also known. The applicant's U.S. Patent Number 5,437,093 which issued August 1, 1995, shows a method wherein an injection molding nozzle is made by first brazing an inner core, an outer collar portion and an outer sleeve together by heating to a temperature above a first melting temperature and then casting an electrical heating element into the space between them by heating to a temperature above a second lower melting temperature.

The previous apparatus and methods have the disadvantage that the portion providing the tip is either screwed or pressure fitted into place and therefore does not provide optimal heat transfer.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present

invention to at least partially overcome the disadvantages of the prior art by providing a method of making an integral injection molding heating nozzle by integrally brazing a tip insert into a seat in the front end of the inner portion of the nozzle.

To this end, in one of its aspects, the invention provides a method of making an integral heated injection molding nozzle comprising the following steps. Making an elongated inner portion having a rear end, a front end, a melt bore extending therethrough from the rear end to the front end, and a general cylindrical outer surface with a spiral groove extending therearound. Making an outer collar portion to fit around the inner portion adjacent the rear end of the inner portion, the outer collar portion having a radial opening therethrough. Winding an electrical heating element into the spiral groove extending around the outer surface of the inner portion and mounting the outer collar portion in place around the inner portion with a terminal portion of the heating element extending outwardly through the radial opening through the outer collar portion. Closing in the radial opening around the at least one terminal portion. Applying a first brazing material having a predetermined melting temperature between the inner portion and the surrounding outer collar portion. Integrally brazing the inner portion, the outer collar

portion, and the electrical heating element together by heating them in a substantially oxygen free atmosphere in a vacuum furnace to a temperature above the melting temperature of the first brazing material. Machining the integral nozzle to provide a desired outer shape and finish. Making a seat extending around the melt bore at the front end of the inner portion of the nozzle. Making a tip insert having a rear end, a rear portion extending forwardly from the rear end, a tip portion extending forwardly from the rear portion, and a melt bore extending forwardly therethrough from the rear end. The rear portion is made to fit in the seat at the front end of the inner portion of the nozzle with the melt bore through the tip insert extending from the melt bore through the inner portion of the nozzle. Inserting the tip insert into the matching seat at the front end of the inner portion of the nozzle. Then applying a second brazing material where the tip insert and the inner portion of the nozzle join, the second brazing material having a predetermined melting temperature substantially lower than the melting temperature of the first brazing material. Finally, integrally brazing the tip insert in place in the inner portion by heating them to a temperature above the melting temperature of the second brazing material and below the melting temperature of the first brazing material.

Further objects and advantages of the invention will appear from the following description taken together with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of an integral heated injection molding nozzle made according to a first embodiment the invention,

Figure 2 is a bottom view of the heated injection molding nozzle seen in Figure 1,

Figure 3 is an exploded isometric view of the components that are brazed together in the first brazing step according to the first embodiment of the invention,

Figure 4 is a sectional view showing the same components assembled together,

Figure 5 is a schematic view showing the assembly from Figure 4 in position to be inserted into a vacuum furnace,

Figure 6 is an isometric view showing a tip insert in position to be inserted into a seat in the front end of the nozzle according to the first embodiment of the invention,

Figure 7 is an isometric view showing the tip insert seated in the front end of the nozzle,

Figure 8 is a sectional view showing a nozzle

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made according to another embodiment of the invention having a tip with a single angled tip portion,

Figure 9 is a sectional view showing a nozzle made according to another embodiment of the invention having a tip with a pair of angled tip portions, and

Figure 10 is an isometric view showing a nozzle made according to a further embodiment of the invention having a tip with four angled tip portions.

DETAILED DESCRIPTION OF THE INVENTION

Reference is first made to Figures 1 and 2 which show an integral heated injection molding nozzle 10 made by a first embodiment of the present invention. The nozzle 10 has an elongated inner portion 12 with a rear end 14 and a front end 16. The nozzle 10 is seated in a mold (not shown) and has a central melt bore 18 extending through the inner portion 12 to convey melt to a gate (not shown). The nozzle 10 also has an integral outer collar portion 20 which fits around the elongated inner portion 12 adjacent its rear end 14. While the outer collar portion 20 is normally made of H13 hot work tool steel, the inner portion 12 may be made of a different material such as stainless steel or a beryllium nickel alloy having different thermal characteristics to provide the nozzle 10 with the thermal balance required for different materials being molded. In

this embodiment, the outer collar portion 20 is made with threaded bolt holes 21 to receive bolts (not shown) to secure it to a melt distribution manifold.

5 The inner portion 12 of the nozzle 10 has a generally cylindrical outer surface 22 with an outwardly extending head 24 at its rear end 14. The head 24 fits tightly in a seat 26 in the outer collar portion 20. The outer collar portion 20 has a circular inner flange 28 against which the head 24 of the inner portion 12 abuts. 10 The outer collar portion 20 also has a cylindrical skirt 30 which extends forwardly around but spaced from the outer surface 22 of the inner portion 12 to locate the nozzle 10 in the mold (not shown). An integral electrical heating element 32 extends in a spiral groove 34 extending around the outer surface 22 of the inner portion 12 of the nozzle 10. 15 The heating element 32 has terminal portions 36 which in this embodiment extends outwardly through holes 38 through a terminal locating and sealing key 40 received in a slot 42 in the outer collar portion 20 of the nozzle 10.

20 The nozzle 10 also has a tip insert 44 brazed into a seat 46 at the front end 16 of the inner portion 12 of the nozzle 10. The tip inserts 44 are made according to this embodiment of the invention of a suitable material such as a tungsten carbide alloy have a rear portion 48 and 25 one tip portion 50 with a conical outer surface 52

extending centrally forward to a tip 54. Each tip insert 44 also has a tapered melt bore 56 extending forwardly from its rear end 58 through the rear portion 48 and the tip portion 50. As can be seen, in this embodiment the melt bore 56 through the tip insert 44 has a rear portion 58 aligned with the central melt bore 18 through the inner portion 12 of the nozzle 10 and a front portion 60 extending diagonally outward to the outer conical surface 52. The rear portion 48 of the tip insert 44 and the matching seat 46 at the front end 16 of the inner portion 12 made according to this embodiment of the invention are cylindrical. However, in other embodiments of the invention they can have other suitable matching shapes.

The integral heated nozzle 10 also has a locating and sealing ring stopper sleeve 62 integrally mounted around the cylindrical outer surface 22 of the inner portion 12. This allows a ribbed locating and sealing ring 64 to be removably mounted to abut against a forwardly facing outer shoulder 66 extending around the locating and sealing ring stopper sleeve 62.

Reference will now also be made to Figures 3 - 6 to describe a method of making the integral heated injection molding nozzle 10 according to one embodiment of the invention. Firstly, the components of the integral heated nozzle 10 are made as shown in Figure 3. The inner

portion 12 of the nozzle 10 is made of a suitable material such as H13 tool steel to have the generally cylindrical outer surface 22 with the spiral groove 34 in it and the outwardly extending head 24 at its rear end 14. The inner portion 12 is made by conventional machining or by metal injection molding. The outer collar portion 20 is made with the inner flange 28 which fits around the inner portion 12 and has the slot 42 providing a radial opening therethrough. The outer collar portion 20 is similarly made by conventional machining or by metal injection molding of a suitable material such as H13 tool steel, stainless steel or a beryllium nickel alloy.

In this embodiment, the locating and sealing ring stopper sleeve 62 is made similarly of a suitable material such as H13 tool steel. It is made with the forwardly facing outer shoulder 66 and a cylindrical inner surface 68 which fits over the cylindrical outer surface 22 of the inner portion 12. The terminal locating and sealing key 40 having the holes 38 through it and a pin portion 70 extending inwardly therefrom is made similarly of a suitable material such as H13 tool steel to fit in the slot 42 in the outer collar portion 20. The heating element 32 is made in a conventional manner with insulative compacted magnesium oxide powder extending around a central resistance wire in an outer stainless steel casing 72.

As best seen in Figure 6, the tip insert 44 is made by machining it of a suitable material such as a tungsten carbide alloy. In this embodiment, it is made to have a rear portion 48 and a single tip portion 50 with a conical outer surface 52 extending centrally forward to a tip 54. It is made with a tapered melt bore 56 having a central rear portion 58 and a front portion 60 extending diagonally outward from the rear portion 58 to the outer conical surface 52.

Next, the electrical heating element 32 is wound in the spiral groove 34 in the outer surface 22 of the inner portion 12. The inner portion 12 is then inserted through the outer collar portion 20 with the head 24 of the inner portion 12 abutting against the circular inner flange 28 of the outer collar portion 20 and the terminal portions 36 of the heating element 32 extending out through the slot 42 in the outer collar portion 20. The locating and sealing ring stopper sleeve 62 is mounted around the inner portion 12 and tack welded in place adjacent the front end 16 of the inner portion 12. The two terminal portions 36 of the heating element 32 are inserted through the two holes 38 and the terminal locating and sealing key 40 is pushed inwardly to its assembled position in the matching slot 42 in the outer collar portion 20 with the pin portion 66 received in a hole 74 in the inner portion 12. Then,

with the assembled components in the upright position shown in Figure 4, a quantity of a first conductive brazing material having a suitable melting temperature such as a nickel alloy powder 76 is poured into the space 78 between the cylindrical outer surface 22 of the inner portion 12 and the skirt 30 of the outer collar portion 20. A bead 79 of the first conductive brazing material such as a nickel alloy paste 79 is applied at the front end 16 of the inner portion 12 adjacent the locating and sealing ring stopper sleeve 62.

The assembled components are then loaded (usually in batches) into a vacuum furnace 80 as seen in Figure 5. As the vacuum furnace 80 is gradually heated to a first temperature of approximately 1950° F. which is above the melting point of the first nickel alloy brazing material powder 76 and paste 79, it is evacuated to a relatively high vacuum to remove substantially all of the oxygen. The vacuum is then reduced by partially backfilling the vacuum furnace 80 with an inert gas such as argon or nitrogen to avoid sputtering. This melts the first nickel alloy brazing powder 76 which flows by capillary action upwardly along the heating element 32 in the spiral grooves 34 and also between the inner portion 12 and the outer collar portion 20. It also melts the first nickel alloy brazing paste 79 which flows by capillary

action between the inner portion 12 and the locating and sealing ring stopper sleeve 62 to integrally braze them all together. Brazing them together like this in a partial vacuum produces a metallurgical bonding of the nickel alloy brazing material 76 between them which in turn provides improved heat transfer between them.

After cooling, the integral nozzles 10 are removed from the vacuum furnace 80 and a tip insert 44 is mounted in place with its rear portion 48 in the matching seat 46 at the front end 16 of the inner portion 12 of the nozzle 10. A second conductive brazing material 82 such as a silver alloy having a suitable melting temperature substantially below the melting temperature of the first brazing material 76 is then applied around the tip insert 44 and the nozzles 10 are again loaded in batches into the vacuum furnace 80. In other embodiments, copper or brass type alloys having a melting temperature substantially below the melting temperature of the first nickel alloy brazing material 70 can be used. The vacuum furnace 80 is then gradually heated to a second temperature of approximately 850°F which is above the melting temperature of the second silver alloy brazing material 82 but below the melting point of the first conductive brazing material 76. As the vacuum furnace 80 is gradually heated it is again evacuated to a relatively high vacuum to remove

substantially all of the oxygen. The vacuum is then reduced by partially backfilling the vacuum furnace 80 with an inert gas such as argon or nitrogen to avoid sputtering. This melts the second silver alloy brazing material 82 which runs between the tip insert 44 and the surrounding inner portion 12 of the nozzle 10 to integrally braze them together. Brazing them together like this in a partial vacuum produces a metallurgical bonding of the silver alloy brazing material 82 between them to provide an integral injection molding heated nozzle 10 having very improved thermal characteristics. However, in an alternate embodiment of the invention, the tip insert 44 can be integrally brazed in place (or removed) by heating the nozzle 10 to the second temperature of approximately 850°F just using the integral heating element 32 without insertion into the vacuum furnace. While a silver alloy second brazing material 82 is used in this embodiment, in other embodiments a copper alloy or other suitable second brazing material 82 can be used. The silver alloy second brazing material 82 having a melting temperature substantially below the melting temperature of the nickel alloy first brazing material 76 allows the tip insert 44 to be integrally brazed in place without melting the nickel alloy first brazing material 76. Similarly, it allows the tip insert 44 to be removed for replacement by again

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heating the nozzle 10 to this same second temperature without affecting the metallurgical bond between the other components of the nozzle 10.

The integral heated injection molding nozzle 10 is then machined to give it the desired outer shape and finish.

In use, the integral heated injection molding nozzle 10 is attached to a melt distribution manifold mounted in a mold (not shown) and electrical power is applied to the heating element 32 to heat it to a predetermined operating temperature. Pressurized melt is applied to the melt distribution manifold from a molding machine (not shown) according to a predetermined injection cycle. The melt flows through the central melt bore 18 in the heated nozzle 10 and the aligned melt bore 56 in the tip insert 44 to a gate (not shown) leading to a cavity in the mold. After the cavities are filled and a suitable packing and cooling period has expired, the injection pressure is released and the melt conveying system is decompressed to avoid stringing through the open gates. The mold is then opened to eject the molded products. After ejection, the mold is closed and the cycle is repeated continuously with a cycle time dependent upon the size of the cavities and type of material being molded.

Reference is now made to Figure 8 which shows

another embodiment of the method of making a integral heated injection molding nozzle 10 having an integral tip insert 44. In this embodiment, the tip insert 44 is made with the tip portion 50 extending diagonally outward from the rear portion 58 and the melt bore 56 extending centrally therethrough. The remainder of the method is the same and need not be repeated.

Reference is now made to Figure 9 which shows another embodiment of the method of making an integral heated injection molding nozzle 10 having an integral tip insert 44. In this embodiment, the tip insert 44 is made with a pair of tip portions 50 extending diagonally outward from the rear portion 48 and the melt bore 56 extending centrally therethrough. As can be seen, the tip portions 50 are made with a shape and size that allows the ribbed locating and sealing ring 64 to fit over them.

Reference is now made to Figure 10 which shows a further embodiment of the method of making an integral heated injection molding nozzle 10 having an integral tip insert 44. In this embodiment, the tip insert 44 is made with four tip portions 50 extending diagonally outward from the rear portion 48 and the melt bore 56 extending centrally therethrough. The nozzles 10 shown in Figures 8, 9 and 10, wherein the tip insert 44 has one or more tip portions 50 extending diagonally outward, all have a pin 84

extending between the tip insert 44 and the inner portion 12 of the nozzle 10 to locate the tip insert 44 relative to a reference bore 86 in the outer collar portion 20 shown in Figure 1. This enables the nozzle 10 to be mounted with each tip 50 very accurately aligned in the center of the gate.

While the description of the method of making the integral heated injection molding nozzle 10 has been given with respect to preferred embodiments, it will be evident that various other modifications are possible without departing from the scope of the invention as understood by those skilled in the art and as defined in the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. In a method of making an integral heated injection molding nozzle comprising the steps of:

(a) making an elongated inner portion having a rear end, a front end, a melt bore extending therethrough from the rear end to the front end, and a general cylindrical outer surface with a spiral groove extending therearound,

(b) making an outer collar portion to fit around the inner portion adjacent the rear end of the inner portion, the outer collar portion having a radial opening therethrough,

(c) winding an electrical heating element into the spiral groove extending around the outer surface of the inner portion, mounting the outer collar portion in place around the inner portion with at least one terminal portion of the heating element extending outwardly through the radial opening through the outer collar portion, and closing in the radial opening around the at least one terminal portion,

(d) applying a first brazing material having a predetermined melting temperature between the

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inner portion and the surrounding outer collar portion,

(e) integrally brazing the inner portion, the outer collar portion, and the electrical heating element together by heating them in a substantially oxygen free atmosphere in a vacuum furnace to a temperature above the melting temperature of the first brazing material, and

(f) machining the integral nozzle to provide a desired outer shape and finish, the improvement comprising the further steps of:

(g) making a seat extending around the melt bore at the front end of the inner portion of the nozzle,

(h) making a tip insert having a rear end, a rear portion extending forwardly from the rear end, at least one tip portion extending forwardly from the rear portion, and a melt bore extending forwardly therethrough from the rear end, the rear portion being made to fit in the seat at the front end of the inner portion of the nozzle with the melt bore through the tip insert extending from the melt bore through the inner portion of the nozzle,

(i) inserting the tip insert into the matching

seat at the front end of the inner portion of the nozzle,

(j) applying a second brazing material where the tip insert and the inner portion of the nozzle join, the second brazing material having a predetermined melting temperature substantially lower than the melting temperature of the first brazing material, and

(k) integrally brazing the tip insert in place in the inner portion by heating them to a temperature above the melting temperature of the second brazing material and below the melting temperature of the first brazing material.

2. A method of making an integral heated injection molding nozzle as claimed in claim 1 wherein step (k) comprises heating in a substantially oxygen free atmosphere in a vacuum furnace.

3. A method of making an integral heated injection molding nozzle as claimed in claim 2 including making the seat around the melt bore at the front end of the inner portion of the nozzle cylindrical and also making the rear portion of the tip insert cylindrical to fit in said cylindrical seat.

4. A method of making an integral heated injection molding nozzle as claimed in claim 3 including making the cylindrical seat around the melt bore at the front end of the inner portion of the nozzle by machining.

5. A method of making an integral heated injection molding nozzle as claimed in claim 4 further including the step of:

(l) making a locating and sealing ring stopper sleeve having a cylindrical inner surface and a forwardly facing outer shoulder, the inner surface being made to fit over the front end of the inner portion of the nozzle, and

(m) mounting the locating and sealing ring stopper sleeve on the inner portion of the nozzle with the sealing ring stopper sleeve adjacent the front end of the inner portion of the nozzle before step (e), whereby step (e) integrally brazes the locating and sealing ring stopper sleeve around the inner portion of the nozzle.

6. A method of making an integral heated injection molding nozzle as claimed in claim 5 wherein closing in the radial opening through the outer collar portion around the at least one terminal portion of the electrical heating

element comprises making the outer collar portion with the radial opening therethrough being a slot and inserting into said slot a terminal locating and sealing key with at least one hole therethrough to receive the at least one terminal locating and sealing portion therethrough before step (d), whereby step (e) integrally brazes the terminal locating and sealing key in said slot.

7. A method of making an integral heated injection molding nozzle as claimed in claim 6 wherein the first brazing material is a nickel alloy.

8. A method of making an integral heated injection molding nozzle as claimed in claim 7 wherein the second brazing material is a silver alloy.

9. A method of making an integral heated injection molding nozzle as claimed in claim 8 including making the tip insert of a tungsten carbide alloy.

10. A method of making an integral heated injection molding nozzle as claimed in claim 4 wherein step (h) comprises making the tip insert with one tip portion having a conical outer surface extending centrally forward from the rear portion, with the melt bore extending therethrough

having a central rear portion and a front portion extending diagonally outward from the central rear portion to the conical outer surface.

11. A method of making an integral heated injection molding nozzle as claimed in claim 4 including making a bore between the tip insert and the matching seat at the front end of the inner portion of the nozzle and inserting a locating pin into said bore to accurately orienting the tip insert relative to the inner portion of the nozzle to allow the tip portion of the nozzle to be accurately oriented with a gate.

12. A method of making an integral heated injection molding nozzle as claimed in claim 11 wherein step (h) comprises making the tip insert with one tip portion 50 having a conical outer surface extending diagonally outward from the rear portion, with the melt bore extending centrally therethrough.

13. A method of making an integral heated injection molding nozzle as claimed in claim 11 wherein step (h) comprises making the tip insert with a pair of tip portions having conical outer surfaces extending diagonally outward from the rear portion, with the melt bore extending

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14. A method of making an integral heated injection molding nozzle as claimed in claim 11 wherein step (h) comprises making the tip insert with four tip portions having conical outer surfaces extending diagonally outward from the rear portion, with the melt bore extending centrally therethrough.

**APPARTUS AND METHOD OF MAKING AN INJECTION MOLDING
NOZZLE WITH TIP INSERT**

BACKGROUND OF THE INVENTION

This invention relates generally to injection molding and more particularly to apparatus and a method of making a heated injection molding nozzle with a tip insert.

As seen in the applicant's U.S. Patent Numbers 4,557,685 which issued December 10, 1985 and 4,768,283 which issued September 6, 1988, injection molding nozzles having a tip aligned with the gate to provide hot tip molding are well known. Apparatus having a hot tip provided by a torpedo seated in the front end of a nozzle is also known. For instance, the applicant's Canadian Patent Application Number 2,082,700 which was laid open May 13, 1994 shows a torpedo having a tip held in place by a nozzle seal which slides into a seat in the front end of the nozzle. U.S. Patent Number 5,658,604 to Gellert et al.

invention to at least partially overcome the disadvantages of the prior art by providing apparatus and a method of making an integral injection molding heating nozzle by integrally brazing a tip insert into a seat in the front end of the inner portion of the nozzle.

To this end, in one of its aspects, the invention provides a method of making an integral heated injection molding nozzle comprising the following steps. Making an elongated inner portion having a rear end, a front end, a melt bore extending therethrough from the rear end to the front end, and a general cylindrical outer surface with a spiral groove extending therearound. Making an outer collar portion to fit around the inner portion adjacent the rear end of the inner portion, the outer collar portion having a radial opening therethrough. Winding an electrical heating element into the spiral groove extending around the outer surface of the inner portion and mounting the outer collar portion in place around the inner portion with a terminal portion of the heating element extending outwardly through the radial opening through the outer collar portion. Closing in the radial opening around the at least one terminal portion. Applying a first brazing material having a predetermined melting temperature between the inner portion and the surrounding outer collar portion. Integrally brazing the inner portion, the outer collar

extending centrally forward to a tip 54. Each tip insert 44 also has a tapered melt bore 56 extending forwardly from its rear end 57 through the rear portion 48 and the tip portion 50. As can be seen, in this embodiment the melt bore 56 through the tip insert 44 has a rear portion 58 aligned with the central melt bore 18 through the inner portion 12 of the nozzle 10 and a front portion 60 extending diagonally outward to the outer conical surface 52. The rear portion 48 of the tip insert 44 and the matching seat 46 at the front end 16 of the inner portion 12 made according to this embodiment of the invention are cylindrical. However, in other embodiments of the invention they can have other suitable matching shapes.

The integral heated nozzle 10 also has a locating and sealing ring stopper sleeve 62 integrally mounted around the cylindrical outer surface 22 of the inner portion 12. This allows a ribbed locating and sealing ring 64 to be removably mounted to abut against a forwardly facing outer shoulder 66 extending around the locating and sealing ring stopper sleeve 62.

Reference will now also be made to Figures 3 - 6 to describe a method of making the integral heated injection molding nozzle 10 according to one embodiment of the invention. Firstly, the components of the integral heated nozzle 10 are made as shown in Figure 3. The inner

The embodiments of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. Injection molding apparatus comprising a nozzle (10) with a heater (32), an inner portion (12) having a melt bore (18) extending therethrough, and a tip insert (44) metalurgically bonded to the front end (16) of the inner portion (12).
2. Injection molding apparatus as claimed in claim 1 wherein the tip insert (44) is brazed to the front end(16) of the inner portion (12),
3. Injection molding apparatus as claimed in claim 2 wherein the heater is an electrical heating element (32).
4. Injection molding apparatus as claimed in claim 3 wherein the heating element (32) is integrally brazed into a spiral groove (34) extending around the outer surface (22) of the inner portion (12).
5. Injection molding apparatus as claimed in claim 4 where the electrical heater is brazed using a first material (76) and the tip insert (44) is brazed using a second material (82) and having a lower melting temperature than the said first material (76).

6. Injection molding apparatus as claimed in claim 2 wherein the tip insert (44) has at least one tapered front tip (54).

7. Injection molding apparatus as claimed in claim 6 wherein the at least one tapered front tip (54) extends diagonally outward.

8. Injection molding apparatus comprising a nozzle (10) with a heater (32), an inner portion (12) having a melt bore (18) extending therethrough, a collar portion (20) metalurgically bonded to the inner portion (12) using a first material (76), and a tip insert (44) metalurgically bonded to the inner portion (12) using a second material (82).

9. Injection molding apparatus as claimed in claim 8 wherein the collar portion (20) and the tip insert (44) are brazed to the inner portion (12).

10. Injection molding apparatus as claimed in claim 9 wherein the second material (82) has a lower melting temperature than the first material (76).

11. Injection molding apparatus as claimed in claim 10 wherein the heater is an electrical heating element (32).

12. Injection molding apparatus as claimed in claim 11 wherein the heating element (32) is integrally brazed in a

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spiral groove (34) extending around the outer surface 922) of the inner portion (12).

13. A method of making an injection molding nozzle (10) with a heater (32) comprising making an inner portion (12) with a melt bore (18) extending therethrough and metalurgically bonding a tip insert (44) to the front end (16) of the inner portion (12).

14. A method of making an injection molding nozzle (10) as claimed in claim 13 including brazing the tip insert (44) to the front end (16) of the inner portion (12).

15. A method of making an injection molding nozzle (10) as claimed in claim 14 wherein the brazing is carried out at a relatively low temperature.

16. A method of making an injection molding nozzle (10) as claimed in claim 14 wherein the tip insert (44) has at least one tapered front tip (54).

17. A method of making an injection molding nozzle (10) as claimed in claim 16 wherein the at least one tapered front tip (54) extends diagonally outward.

18. A method of making an injection molding nozzle (10) with a heater (32) and a melt bore (18) extending therethrough comprising metalurgically bonding an inner portion (12) and a collar portion (20) together at a first temperature, and metalurgically bonding a tip insert (44) to

the front end (16) of the inner portion (12) at a second temperature.

19. A method of making an injection molding nozzle (10) as claimed in claim 19 including brazing the inner portion (12), collar portion (20) and tip insert (44) together.

20. A method of making an injection molding nozzle (10) as claimed in claim 20 wherein the second temperature is lower than the first temperature.

21. In a method of making an integral heated injection molding nozzle (10) comprising the steps of:

(a) making an elongated inner portion (12) having a rear end (14), a front end (16), a melt bore (18) extending therethrough from the rear end (14) to the front end (16), and a general cylindrical outer surface (22),

(b) making an outer collar portion (20) to fit around the inner portion (12) adjacent the rear end (14) of the inner portion (12), the outer collar portion (20) having a radial opening (42) therethrough,

(c) winding an electrical heating element (32) around the outer surface (22) of the inner portion (12), mounting the outer collar portion (20) in place around the inner portion (12) with at least one terminal portion (36) of the heating element (32) extending outwardly through the radial opening (42) through the outer collar portion (20),

and closing in the radial opening (42) around the at least one terminal portion (30),

(d) applying a first brazing material (76) having a predetermined melting temperature between the inner portion (12) and the surrounding outer collar portion (20), and

(e) integrally brazing the inner portion (12) and the outer collar portion (20) together by heating them in a furnace to a temperature above the melting temperature of the first brazing material (76), the improvement comprising the further steps of:

(f) making a seat (46) extending around the melt bore (18) at the front end (16) of the inner portion (12) of the nozzle,

(g) inserting a tip insert (44) into the matching seat (46) at the front end (16) of the inner portion (12) of the nozzle (10), the tip insert (44) having a rear end (57), a rear portion (48) extending forwardly from the rear end (57), at least one tip portion (50) extending forwardly from the rear portion (48), and a melt bore (56) extending forwardly therethrough from the rear end (57), the rear portion (48) being made to fit in the seat (46) at the front end (16) of the inner portion (12) of the nozzle (10) with the melt bore (18) through the tip insert (44) extending from the melt bore (18) through the inner portion (12) of the nozzle (10),

(h) applying a second brazing material (82) where the tip insert (44) and the inner portion (12) of the nozzle (10) join, the second brazing material

(82) having a predetermined melting temperature substantially lower than the melting temperature of the first brazing material (76), and
(i) integrally brazing the tip insert (44) in place in the inner portion (12) by heating them to a temperature above the melting temperature of the second brazing material (82) and below the melting temperature of the first brazing material (76).

22. A method of making an integral heated injection molding nozzle (10) as claimed in claim 4 wherein step (k) comprises heating in a substantially oxygen free atmosphere in a vacuum furnace (80).

23. A method of making an integral heated injection molding nozzle (10) as claimed in claim 23 including making the seat (46) around the melt bore (18) at the front end (16) of the inner portion of the nozzle cylindrical and also making the rear portion (12) of the tip insert (44) cylindrical to fit in said cylindrical seat (46).

24. A method of making an integral heated injection molding nozzle (10) as claimed in claim 24 including making the cylindrical seat (46) around the melt bore (18) at the front end (16) of the inner portion (12) of the nozzle (10) by machining.

25. A method of making an integral heated injection molding nozzle (10) as claimed in claim 24 further including the steps of:

(l) making a locating and sealing ring stopper sleeve (62) having a cylindrical inner surface (68) and a forwardly facing outer shoulder (66), the inner surface (68) being made to fit over the front end (16) of the inner portion (12) of the nozzle (10), and

(m) mounting the locating and sealing ring stopper sleeve (62) on the inner portion (16) of the nozzle (10) with the sealing ring stopper sleeve (62) adjacent the front end (16) of the inner portion (12) of the nozzle (10) before step (e), whereby step (e) integrally brazes the locating and sealing ring stopper sleeve (62) around the inner portion (16) of the nozzle (10).

26. A method of making an integral heated injection molding nozzle (10) as claimed in claim 26 wherein closing in the radial opening (42) through the outer collar portion (20) around the at least one terminal portion (36) of the electrical heating element (32) comprises making the outer collar portion (20) with the radial opening (42) therethrough being a slot (42) and inserting into said slot (42) a terminal locating and sealing key (40) with at least one hole (38) therethrough to receive the at least one terminal portion (36) therethrough before step (d), whereby step (e) integrally brazes the terminal locating and sealing key (40) in said slot (42).

27. A method of making an integral heated injection molding nozzle (10) as claimed in claim 27 wherein the first brazing material (76) is a nickel alloy.

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28. A method of making an integral heated injection molding nozzle (10) as claimed in claim 27 wherein the second brazing material (82) is a silver alloy.

30. A method of making an integral heated injection molding nozzle (10) as claimed in claim 29 including making the tip insert (44) of a tungsten carbide alloy.

31. A method of making an integral heated injection molding nozzle (10) as claimed in claim 22 wherein step (h) comprises making the tip insert (44) with one tip portion (50) having a conical outer surface (52) extending centrally forward from the rear portion (48), with the melt bore (56) extending therethrough having a central rear portion (58) and a front portion (60) extending diagonally outward from the central rear portion (58) to the conical outer surface (52).

31. A method of making an integral heated injection molding nozzle (10) as claimed in claim 22 including making a bore between the tip insert (44) and the matching seat at the front end (16) of the inner portion (12) of the nozzle (10) and inserting a locating pin (84) into said bore to accurately orienting the tip insert (44) relative to the inner portion (12) of the nozzle (10) to allow the tip portion of the nozzle (10) to be accurately oriented with a gate.

32. A method of making an integral heated injection molding nozzle (10) as claimed in claim 32 wherein step (h)

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comprises making the tip insert (44) with one tip portion (50) having a conical outer surface (52) extending diagonally outward from the rear portion (48), with the melt bore (56) extending centrally therethrough.

33. A method of making an integral heated injection molding nozzle (10) as claimed in claim 32 wherein step (h) comprises making the tip insert (44) with a pair of tip portions (50) having conical outer surfaces (57) extending diagonally outward from the rear portion (48), with the melt bore (56) extending centrally therethrough.

34. A method of making an integral heated injection molding nozzle (10) as claimed in claim 32 wherein step (h) comprises making the tip insert (44) with four tip portions (50) having conical outer surfaces (52) extending diagonally outward from the rear portion (48), with the melt bore (56) extending centrally therethrough.

ABSTRACT OF THE DISCLOSURE

A method of making a heated injection molding nozzle with an integral tip insert. First, an inner portion, an outer collar portion, and an electrical heating element are made and integrally brazed together in a vacuum furnace using a first nickel alloy brazing material. Then a tip insert is made having a desired configuration and seated in the front end of the inner portion and a second nickel alloy brazing material is applied around it. The second brazing material has a melting temperature which is substantially below that of the first brazing material. The tip insert is then integrally brazed in place by heating them to a temperature above the melting temperature of the second brazing material and below the melting temperature of the first brazing material. In addition to not affecting the metallurgical bonding between the other components, this allows the tip insert to be easily removed for replacement by again heating the nozzle to this same temperature.

FIG. 2

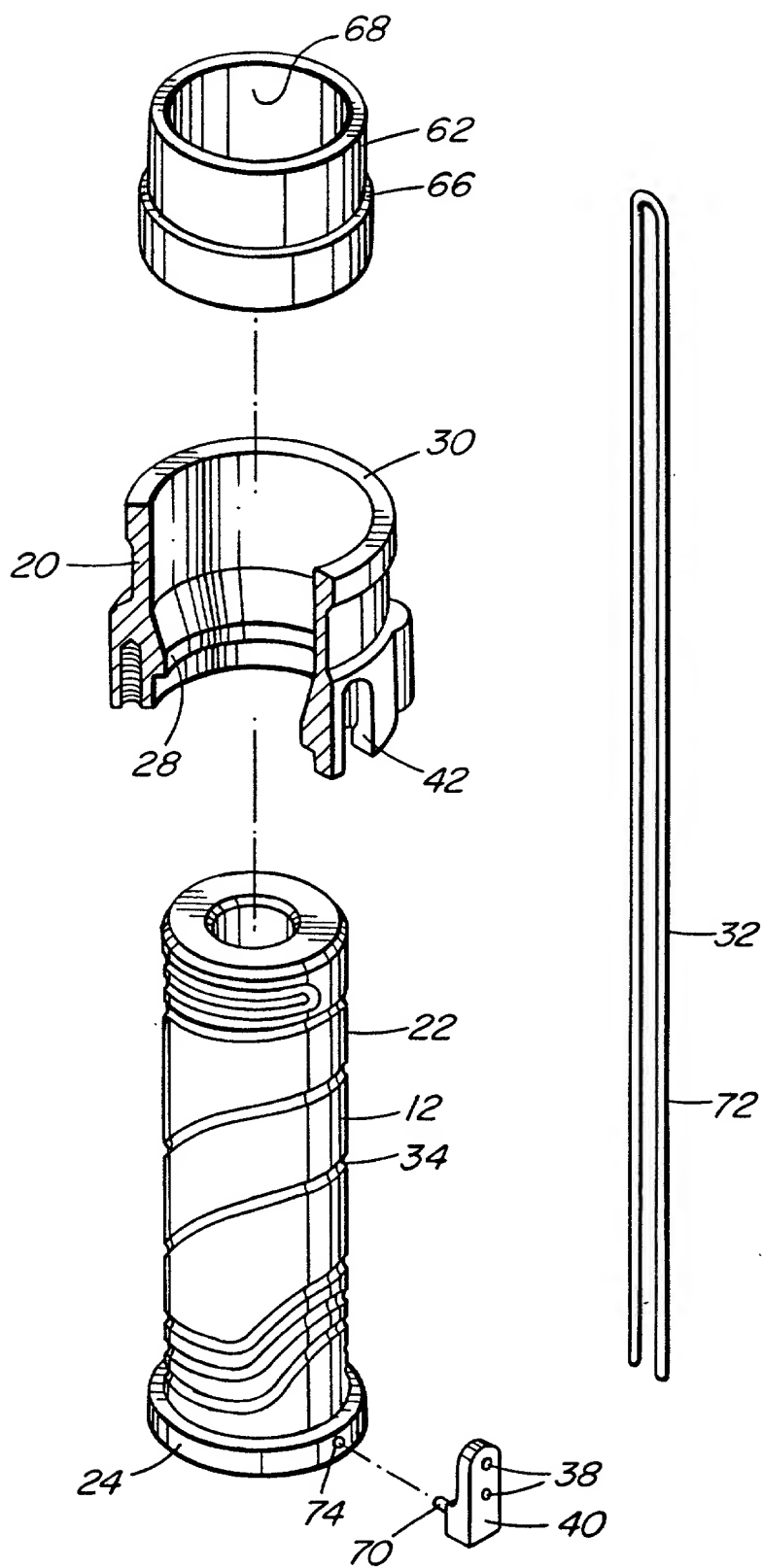
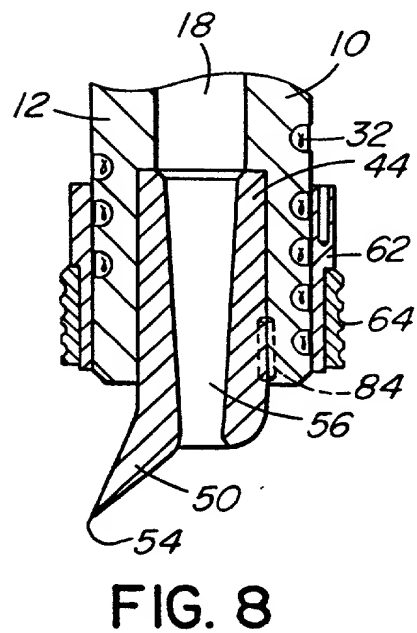
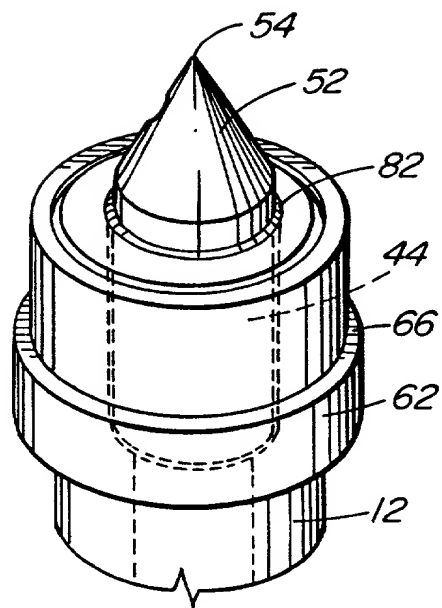
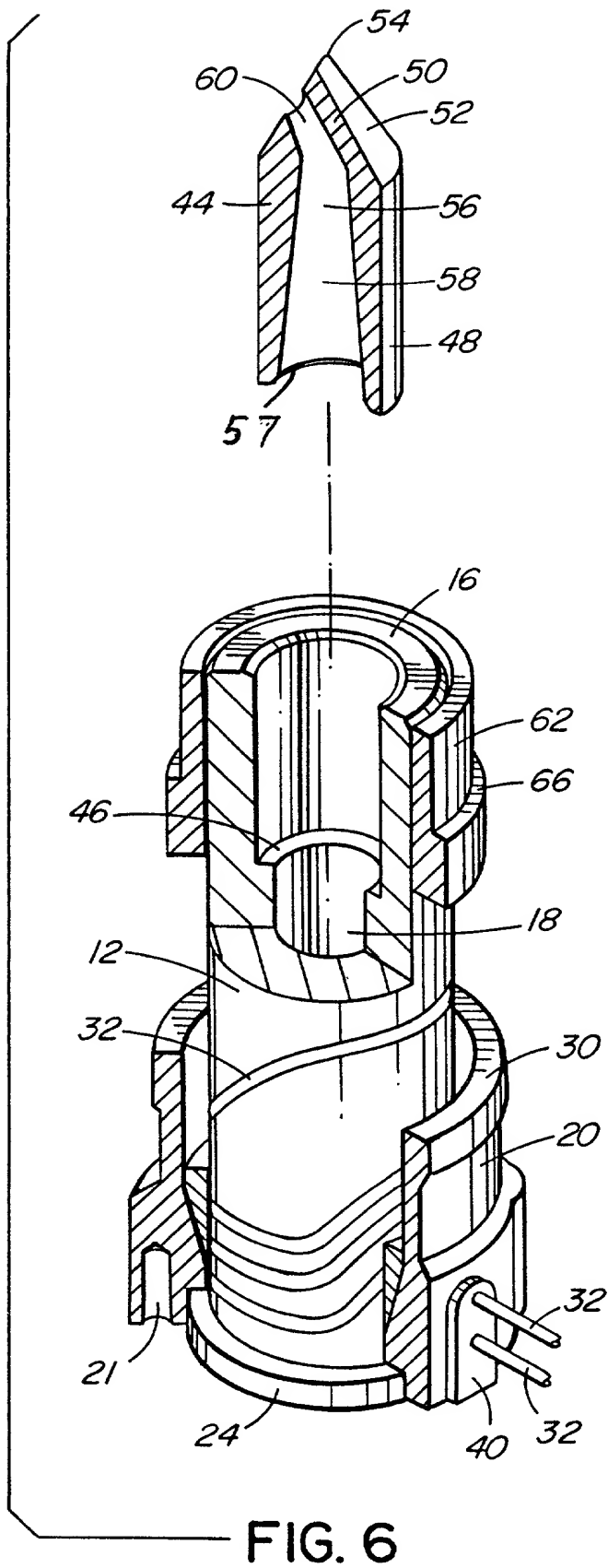


FIG. 3



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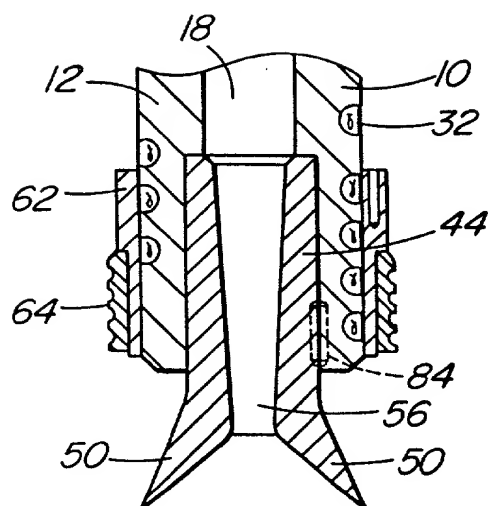


FIG. 9

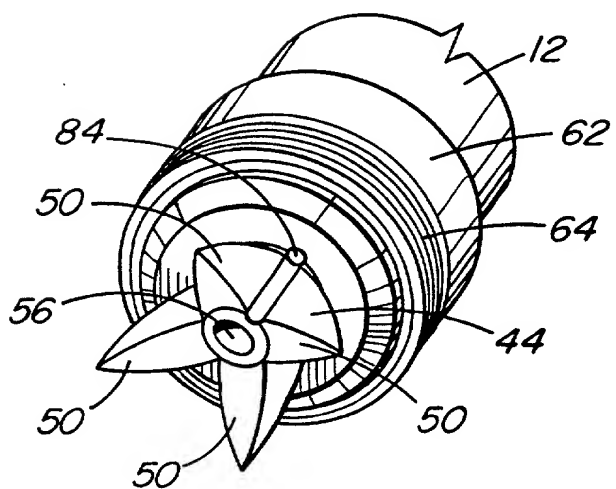


FIG. 10

DECLARATION AND POWER OF ATTORNEY

P98068

Attorney docket No.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"Method of Making An Injection Molding Nozzle with Tip Insert"

the specification of which ☐ is attached hereto or ☒ was filed on November 18, 1998 as Application Serial No. 09/195,095 and was amended on _____ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

COUNTRY	APPLICATION NUMBER	DATE OF FILING	PRIORITY CLAIMED UNDER 35 U.S.C. 119
Canada	2,250,599	October 16, 1998	Yes <u>X</u> No _____
			Yes _____ No _____

I claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT International filing date of this application:

APPLICATION SERIAL NO.	DATE OF FILING	STATUS
		<input type="checkbox"/> Patented <input type="checkbox"/> Pending <input type="checkbox"/> Abandoned
		<input type="checkbox"/> Patented <input type="checkbox"/> Pending <input type="checkbox"/> Abandoned

POWER OF ATTORNEY: I hereby appoint as attorney to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: R.Dale McKenzie, Reg. No. 26,117.

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	POST OFFICE ADDRESS			Zip Code

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 201 <i>Jobst Ulrich</i>	Signature of Inventor 202	Signature of Inventor 203
Date X January 5, 1999	Date	Date